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[Continued on next page]

(54) Title: METHOD AND SYSTEM FOR CONNECTION SET-UP IN A COMMUNICATION SYSTEM COMPRISING SEVERAL SWITCHING UNITS AND SEVERAL PROCESSING UNITS
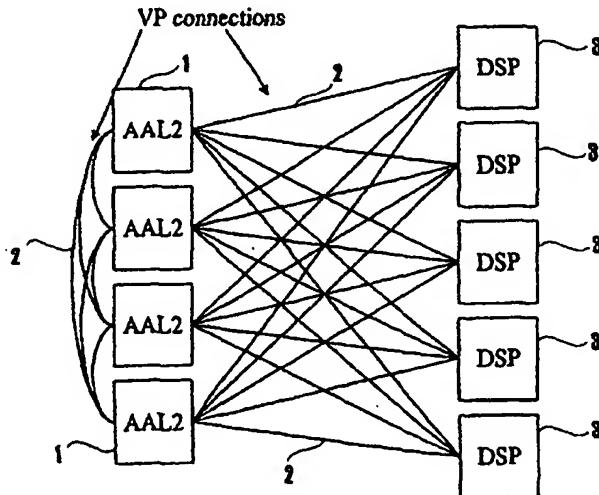
(57) Abstract: The invention provides a method and system for connection set-up in a communication system which comprises a plurality of first processing units, e.g. switching units, and a plurality of second processing units, and transmits information as a stream of information cells having cell identification. For reducing the number of messages in setting up connections, the first processing units are connected to the second processing units, and information cells are supplied to several processing units which distinguish between the cells based on the cell identification for further processing. The information is preferably ATM transmitted, and all first processing units are connected to all second processing units using virtual path connections on the ATM layer. The processing unit to which the information cell is directed is identified using virtual channel.

METHOD AND SYSTEM FOR CONNECTION SET-UP IN A COMMUNICATION
SYSTEM COMPRISING SEVERAL SWITCHING UNITS
AND SEVERAL PROCESSING UNITS

FIELD OF THE INVENTION

The present invention relates to a method and system for the
setup of connections in a communication system comprising
several switching units and several processing units. Such a
system is generally necessary for transmitting information to
a desired destination, for instance in a system using ATM
(Asynchronous Transfer Mode) transmission.

BACKGROUND OF THE INVENTION

In UMTS/3G (Universal Mobile Telecommunication System, Third
generation) mobile networks, RNC (Radio Network Controller)
and ATM (Asynchronous Transfer Mode) module network elements
may be implemented using a concept which has separate
switching units, for instance AAL (ATM Adaptation Layer, such
as AAL2 ATM Adaptation Layer type 2) switching units, and
separate DSP (Digital Signal Processor) processor units. A
DSP is designed for signal and data handling, resembling an
ordinary microprocessor. AAL2 switching units are used for
demultiplexing and multiplexing AAL2 type of traffic from
normal N_cid format to AAL2 1_cid format. N_cid means that
one ATM cell contains several AAL2 microcells. 1_cid means
that ATM cells contain only one AAL2 microcell. The basic
switching function is the functionality when received N_cid
is demultiplexed into 1_cids, and 1_cid, received in other
direction, is multiplexed with other 1_cids to specific

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N_cid. N_cid is always received from, or sent to the network
and l_cid is an internal format between AAL2 switching units
and between AAL2 unit and DSP processor unit. The above
described type of network elements is merely presented as an

5 example. The invention can be implemented in any type of
network elements.

Fig. 4 illustrates the switching topologies in two typical
switching cases. The upper part shows a first typical

10 switching case , whereas the lower part shows another typical
switching case. In Fig. 4 and the other Figures, several
signal processing units such as NIU (Network Interface Unit)
are shown.

15 It is obvious from Fig. 4 that the ATM module switching case
(upper part) contains only three ATM - level connections
whereas the RNC switching case needs four ATM -level cross-
connections. These connections are currently handled under
the leg concept schematically shown in Fig. 5. As illustrated

20 in Fig. 5, ATM connections are provided for interconnecting
the network elements in such a manner that legs are formed
which end between the MDC and right-hand AAL2 element and are
connected by means of a leg connector for finally providing a
through switch connection.

25

The requirements for handling the connection are high and the
creation of an ATM connection is quite complex due to Quality
of Service (QoS) requirements, hardware structure and so on.
For making one ATM connection in the ATM level, a minimum of

30 four messages across the computers inside the switching
system is required. In other structures, it may be possible
to implement such an ATM connection with two messages.
However, in basic cases four cross-connections per one
through switch connection are created.

35

The number of created ATM connections will advantageously be reduced when providing N_cid connections because one N_cid contains several connections. For instance, an N_cid VCC (Virtual Channel Connection) is created only once for 248

5   N_cids (in optimal situation). N_cid is terminated in AAL2 switching unit and there are for each cid one ATM layer level VCC connection. The VCC connection needs to be created every time when a new AAL2 connection is created. The same applies for the case of deletion of connections.

10

In the following, some problems related to these connection setup requirements are discussed. The ATM connection control needs a very fast data management tool to handle all the termination point and cross-connection object setups and

15   deletions. Further, the number of messages required and/or the number of all connection setup/deletions per unit time such as 1 second is very high. MXU's SAR (Multiplexer Unit's Segmentation and Reassembly) and CPU (Central processing unit) processing performance is required to be very high to

20   be adequate for handling the data streams. Moreover, a heavy CAC (Connection Admission Control) load occurs as each setup goes through CAC in several points (corresponding to hardware (HW)).

25   The invention relates, among others, to Virtual Channel and Virtual Path technology. A virtual channel (VC) designates a unidirectional transport of ATM cells associated by a common unique identifier value. A virtual channel connection (VPC) is a concatenation of virtual channel links that forms an ATM

30   connection between a transmitting party and a receiving party, and in which both virtual path and virtual channel identifiers are used. A virtual path (VP) means a unidirectional transport of ATM cells that are associated by a common identifier value. A virtual path connection (VPC) is

35   a concatenation of virtual path links that extends between

the point where the virtual channel identifier values are
assigned and the point where those virtual values are
translated or removed.

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BRIEF SUMMARY OF THE INVENTION

Since the requirements for call handling, especially for BHCA
(Busy Hour Call Attempt), are high and the ATM switching
10   setup is complex, the invention aims at finding a solution
for making connection setup more efficient and provide more
performance to satisfy the performance requirements.

The invention provides, for achieving this task, a method
15   and/or system for connection set-up in a communication system
which comprises a plurality of first processing units and a
plurality of second processing units, and transmits
information as a stream of information cells having cell
identification, wherein the first processing units are
20   connected to the second processing units, and information
cells are supplied to several processing units which
distinguish between the cells based on the cell
identification for further processing. The first processing
units may be AAL switching units and the second processing
25   units may be signal processing units. Alternatively, the
first and second processing units can be AAL switching units,
or may be implemented as signal processing units. Preferably,
the information is ATM transmitted.

30   The first and/or second processing units may each contain one
or more digital signal processing units.

In a preferred embodiment, all first processing units are
connected to all second processing units using virtual path
35   connections on the ATM layer.

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That processing unit to which the information cell is
directed is preferably identified using the virtual channel
identifier.

5

The resources between the first and second processing units
are preferably reserved by virtual path.

In a preferred embodiment, the virtual channel identifiers
10   (VCIs) are known only in the first and second processing
units. Therefore, it is not necessary that the VCIs are known
for example in the switching means provided between the
processing units. This feature reduces the necessary storage
capacity and operational load of the switching means which
15   may be composed for instance of multiplexers and switching
fabric.

The first processing units may be connected to each other by
means of such a switching means, or by a general bus, for
20   example a message bus. The second processing units may be
connected to each other, and/or to the first processing
units, in a similar manner.

Furthermore, the cell identifications are preferably
25   allocated by a resource manager. The resource manager may
deliver the VCIs taking account of the capacity and the
services that are offered by the processing units. The
resource manager preferably also knows all Virtual Path
Identifiers (VPIs).

30

The resource manager preferably takes care of the connection
set-ups between the processing units, and knows the resources
of the processing units.

35   One of the additional advantages of the invention is that the

resource manager does not need much time in calculating for
example the Connection Admission Control (CAC) in every
connection set-up between processing units.

5   The first and/or second processing units may comprise AAL
switching units which preferably differentiate different AALs
by different Virtual Channel Identifiers (VCIs).

The invention provides a virtual path piping (in the
10 following also termed VP-piping) which is a simple and yet
very effective concept which significantly increases the
performance by reducing the amount of required messages in
the connection setup. This concept utilizes only the basic
ATM functionalities and makes advantage of the hardware
15 concept used in the system.

BRIEF DESCRIPTION OF THE FIGURES

20 Fig. 1 shows a basic structure of virtual path connections
between network elements in a preferred embodiment of the
invention;

Fig. 2 illustrates the structure of the AAL switching units;
25
Fig. 3 shows a structure of a DSP arrangement of an
embodiment;

Fig. 4 shows two switching topologies for typical switching
30 cases; and

Fig. 5 is a diagram illustrating the steps for through switch
connection using ATM connections and leg concept.

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DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE
INVENTION

First, the basics of the proposed connection solution using
5   the concept of VP piping (Virtual Path piping) will be
described. Thereafter, a more detailed implementation and
requirements from hardware (HW) and software (SW) point of
view will be discussed.

10   The key idea of the VP piping is to connect all the switching
units in the adaptation layer such as AAL (e.g. AAL2)
switching units, to all processing units such as DSP
processing units, with virtual path connections (VPC). This
leads to the creation of a full mesh topology between the AAL
15   (e.g. AAL2) and DSP units. After creation of this topology
there is no need for making any further ATM-layer level
connection setups at all. It is only necessary that virtual
channels are reserved from the SAR (Segmentation and
Reassembly) devices in the AAL2 and the DSP units to be able
20   to make VCC (Virtual Channel Connection).

Fig. 1 illustrates the resulting topology structure with
fully developed virtual path connections 2 between the AAL
switching units 1 and the DSP (Digital Signal Processor)
25   units 3. The virtual path connections are generated not only
between all switching units 1 and all DSP units 3 but also
between each of the switching units 1 as shown in Fig. 1.

When the VPC (Virtual Path Connection) topology shown in Fig.
30   1 is created beforehand, the number of ATM-layer level
connection setups and deletions are reduced during runtime to
zero.

The basic solution to use VPCs on the ATM layer is no problem
35   for the hardware. Likewise, the VC (Virtual Channel)

reservation is not problematic for the hardware.

DSP units (e.g. Cofigurable DSPs) 2 and AAL2 Units 1 are, in
this embodiment, units with several processors. Each

5   processor is capable of receiving and sending cells (i.e.
processors have SAR capabilities). There is preferably only
one interface for each unit which is shared (commonly used)
by each processor of the respective unit. In such an
environment a capability to transfer a cell (information or

10   message cell) through one interface to the appropriate
processor is needed. Furthermore, the functionality of
sharing this interface between several processors sending at
the same time is necessary.

15   The hardware part of the present invention provides both
these functionalities and comprises a FIFO memory 4 (Fig. 2)
which may consist of an UTOPIA extender and/or a First-In
First-Out buffer. Regarding the specification of UTOPIA, see
for instance TR 100 815 V1.1.1 (1999-02) of ETSI (European

20   Telecommunications Standards Institute), or AF-PHY-0017.000:
"The ATM Forum Technical Committee, UTOPIA Specification,
Level 1, Version 2.01".

Fig. 2 shows an example of an AAL2 switching unit providing

25   this function. The other switching units are similarily
structured. In one direction (towards the processors 5), the
FIFO 4 receives cells and copies each cell to each processor
5. In the other direction, the traffic from the processors 5
is queued in the FIFO 4 and is sent forward in accordance

30   with the first-in first-out method.

(UTOPIA) FIFO functionality in this form means that each cell
is received by all the processors 5 in this unit. The
distinction between which processor will actually use the

35   cell and will not discard it, is made based on the active SAR

channels. The processor's SAR functionality which identifies
the cell (channel is opened with the same VPI,VCI (Virtual
Path Identifier, Virtual Channel Identifier) as is specified
in the received cell) can receive the cell. Processors that
5   do not recognize the VPI, VCI of the received cell are
arranged to discard it.

In this way, it will be ensured that only one processor can
open a specified channel. Because of this rule, i.e. based on
10   the defined ATM functionality, only one processor can receive
the cell and the other processors will discard it.

Fig. 3 shows the structure of a DSP unit, wherein several
groups 6 to 9 of DSPs are provided, with each group being
15   assigned to one of several SAR devices 10 (which may be based
on PowerQuick2, PQ2, concept). Here, the SAR devices 10 are
arranged between an associated group 6, 7, 8, or 9 of DSPs,
and the FIFO memory 4, as shown in Fig. 3.

20   Contrary to a concept in which an used virtual path
identifies a processor, it is essential, according to the
present invention (VP piping), that all the processors in one
unit can share the same VP, and the VC value is used for
distinguishing between the processors. Furthermore, no
25   processor is permanently tied to a certain VC/VP.

According to this hardware solution, each processor has to
discard an average of 75% of all received cells. Any cell
misinsertion ratio counters will therefore be set to high
30   admissible values.

For allowing an easy updating of the UTOPIA FIFO
functionality and providing additional support for the VP
piping, a hardware solution replacing UTOPIA FIFO may be
35   provided which is a switch type of solution.

In the following, the solution will be described from the
software point of view. Regarding the basic functionality,
the software managing the VP-piping will be changed compared
5   to a software managing the system with dynamic legs. The main
issue in setting up of legs is that no setup on the ATM-layer
is required because VP is used. The VPC may be set-up made on
first request between two units, or may be VPC preconfigured.
When the VPC connection means tries to select a used VP, it
10 will be necessary to select another unit because that VP is
already connected. This means that DSP resource manager or
AAL2 connection control cannot select, for routing, an
appropriate VP value individually, and create some VCltp
(Virtual Channel Link Termination Point) below selected VPLtp
15 (Virtual Path Link Termination Point) and create cross
connection between selected VCLtps. This is how the system
works when using dynamical leg setup.

In the new VP-piping concept presented here, the set-up uses
20 a co-operation between DSP RM (Resource Manager) and AAL2
connection control. This co-operation means that both
resource managers select a set of resources (AAL2 switching
unit and DSP processors) where there is still resources
available for a new "connection". The term "set of resources"
25 means the exact processor/DSP processor that is available for
the leg. The processor further defines a set of VPC
connections. A set of VPC connections are all the connections
from one unit (as already stated above, unit's processors
share the VPC). The set of VPCs might be limited below
30 maximum if CAC (Connection Admission Control) functionality
considers certain VPC as fully booked. The sets defined by
both resource managers involved (DSP RM - AAL2 CC (connection
control), or AAL2 CC and AAL2 CC) is compared with each other
- the comparison result indicates the set of possible VPCs to
35 be used for this leg and one of those is selected. These

procedures are the basic rules. Additionally, for example, the macro diversity combining function can further restrict the selection DSP unit to exactly one possible unit since the unit already handles one "sister" leg of same connection. The

5 selection of the AAL2 switching unit may also be restricted to one unit if that unit handles the N_cid required. In these case the set is actually limited to only these sets of VP connections that are possible. In some case there is only VPC possible. If it does not have resource available, the

10 connection needs to be rejected.

The selection of VC-values has to be coordinated because in the VP switching the VCI value is the same in both ends of the connection. This is actually quite a simple task since

15 VCI space under VPC is common for both ends. If selection of VCI value is made in one side and delivered to the other side the process will automatically be successful. Either one will have VCI reserved. If the same VCI should be attempted to be reserved twice, this will not be accepted.

20

In the following the configuration of connections will be described. The configuration of VPCs can take place either beforehand, for instance at the start-up of the whole system, or at the time the first l_cid is created between two units.

25 In the first alternative, the resources for VPC are reserved for the whole time. This means that the resources cannot be used by another connection. This can be a problem in network elements which have no extra switching capacity. However, this solution is simpler to implement and very quick as no

30 delays in the set-up due to VPC setup will be caused.

The second alternative, that is a solution which requests VPC only at the time when the first connection is created between two units, is more complicated to implement, but uses

35 switching resources only when needed and is more suitable for

a system with very limited switching capacity. The setup of a
VP connection may cause a brief delay to connection setup.
However, this concerns only a very small part of the
connection. Furthermore, these situations will presumably
5   occur mostly after restart. This solution can be more
flexible also in a failure situation because it has the means
for VPC setup "by heart", that is adapting to the present
configuration of the network, whereas the other solution is
bound to a fixed configuration.

10

The following explanations deal with the identification of
the VP connections. A VP selection method to select VC sc.
internal routing method is not very usable in the VP piping.
In the VP piping the object to identify is the cross-
15   connection between two units. Thus, the identification is
tied to two units. The units can be identified by internal
interface identifier or by some functional unit index and
type. A unit identified needs further refining for the
identification of the processor in the unit. Also the
20   connection needs to be identified by the VPI values of the
VPC termination point.

Preferably, the connection is identified by using logical
interface ID/VPI pair. The connections can also be identified
25   by using logical interface identifier pair but this means
that VPI values have to be found by other means. The resource
managers usually know each unit logical interfaces so as to
be able to reserve VCLTPs.

30   In the following, some management cases will be considered. A
source of failure cases may be that the resource managers
(DSP RM, AAL2 CC) handle the non-redundant "resource pools"
(AAL2 Termination and switching and DSP units) of the NE
(network element).

35

One basic function of the resource manager is to follow the operationality of the resources. In case of failure in resource the information is transferred to the knowledge of resource manager. Resource manager will use this information
5   to prevent the use of the faulty resource.

It has to be mentioned that prevention of using such a resource is enough since the release of calls is left for signaling.
10

If the functional unit state of a certain processor changes it means that use of this processor must be prevented. However, it is not necessary to release all the connections to that unit since the same connection is shared with the
15   other processors as well. If a top level functional unit state changes it means that all the connections can be released. Every state change possibility needs to be considered before starting the implementation.

20   Regarding to connection admission control (CAC), and especially the resource reservation, several approaches can be taken, such as bulk reservation, or reserving VP bandwidth, while VCs are reserved from SARs. Bulk reservation means that bandwidth for the VPC is allocated as CBR
25   (constant bit rate) with highest estimation of traffic through that link. This approach is favorable if there is enough resource available. However, if the ATM switching resources are limited more resources than are actually used will be reserved. Another solution is that every time a l_cid
30   is reserved inside VPC, the reservation of VPC is increased. This approach uses resources in a more efficient way but is required separately for each connection setup.

The VP-piping setups can be defined with fixed configuration.
35

The invention achieves a significant reduction of messages necessary for establishing connections as compared with a conventional case.

In the following the number of messages sent/received in a

5   practical example of the invention will be listed for several different cases, wherein the number of messages needed in a conventional case are indicated in brackets for comparison purpose.

10   The number of messages for general set-up is 32 (66). The number of messages for set-up between individual units is only 6 (26). For general deletion, 30 (54) messages are exchanged. A deletion between units requires 10 (18) messages. The estimated traffic from RSMU is around 8,100

15   (22,000) messages.

This comparison illustrates the significant reduction of messages to be exchanged and, thus, of processor load for connnecting calls in the shown embodiment.

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CLAIMS

1. Method for connection set-up in a communication system
5 which comprises a plurality of first processing units and a
plurality of second processing units, and transmits
information as a stream of information cells having cell
identification, wherein the first processing units are
connected to the second processing units, and information
10 cells are supplied to several processing units which
distinguish between the cells based on the cell
identification for further processing.

15 2. Method according to claim 1, wherein the first processing
units are AAL switching units and the second processing units
are signal processing units.

20 3. Method according to claim 1, wherein the first and second
processing units are AAL switching units.

4. Method according to claim 1, wherein the first and second
25 processing units are signal processing units.

5. Method according to any one of the preceding claims,
wherein the information is ATM transmitted.
30

6. Method according to any one of the preceding claims,
wherein the first and/or second processing units each contain
one or more digital signal processing units.
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7. Method according to any one of the preceding claims, wherein all first processing units are connected to all second processing units using virtual path connections on the

5   ATM layer.

8. Method according to any one of the preceding claims, wherein the processing unit to which the information cell is

10 directed is identified using the virtual channel identifier.

9. Method according to any one of the preceding claims, wherein resources between the first and second processing

15 units are reserved by virtual path.

10. Method according to any one of the preceding claims, wherein the virtual channel identifiers are known only in the

20 first and second processing units.

11. Method according to any one of the preceding claims, wherein cell identifications are allocated by a resource

25 manager.

12. Method according to any one of the preceding claims, wherein the first and/or second processing units comprise AAL

30 switching units which differentiate different AALs by different Virtual Channel Identifiers (VCIs).

13. System for connection set-up in a communication system

35 which comprises a plurality of first processing units and a

plurality of second processing units, and is arranged for
transmitting information as a stream of information cells
having cell identification, wherein, for setting up
connections, the first processing units are connected to the

5   second processing units, and information cells are supplied
to several processing units which distinguish between the
cells based on the cell identification for further
processing.

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14. System according to claim 13, wherein the first
processing units are AAL switching units and the second
processing units are signal processing units.

15

15. System according to claim 13, wherein the first and
second processing units are AAL switching units.

20   16. System according to claim 13, wherein the first and
second processing units are signal processing units.

17. System according to any one of claims 13 to 16, wherein
25   the information is ATM transmitted.

18. System according to any one of claims 13 to 17, wherein
the first and/or second processing units each contain one or
30   more digital signal processing units.

19. System according to any one of claims 13 to 18, wherein
all first processing units are connected to all second
35   processing units using virtual path connections on the ATM

layer.

20. System according to any one of claims 13 to 19, wherein
5   the processing unit to which the information cell is directed
is identified using the virtual channel identifier.

21. System according to any one of claims 13 to 20, wherein
10 resources between the first and second processing units are
reserved by virtual path.

22. System according to any one of claims 13 to 21, wherein
15 the virtual channel identifiers are known only in the first
and second processing units.

23. System according to any one of claims 13 to 22,
20 comprising a resource manager for allocating the cell
identifications.

24. System according to any one of claims 13 to 23, wherein
25 the first and/or second processing units comprise AAL
switching units which differentiate different AALs by
different Virtual Channel Identifiers (VCIs).

FIG. 1

Fig.2

Fig. 3

4 / 5
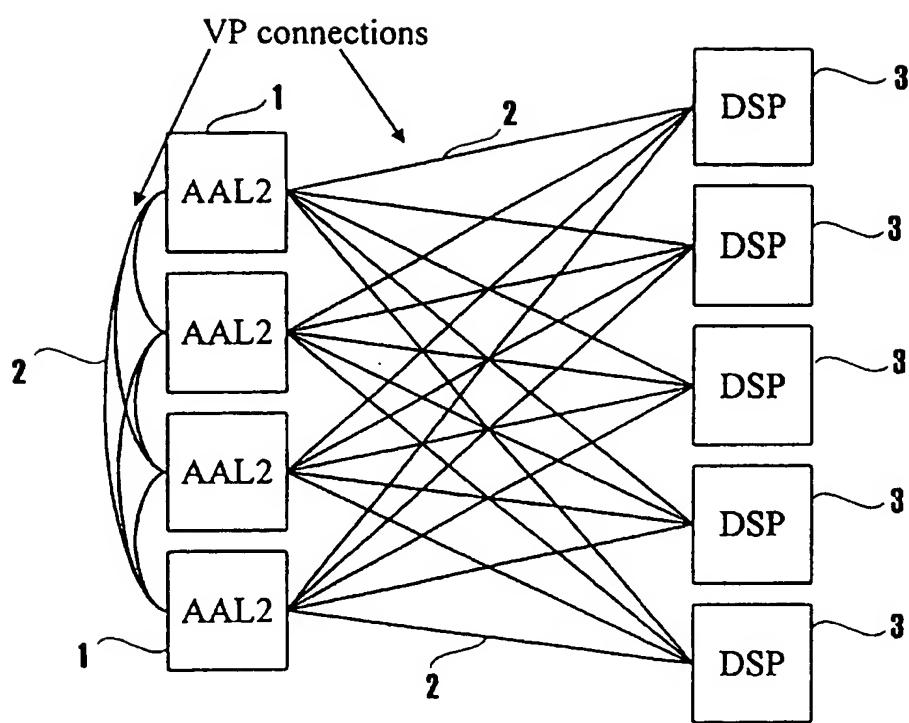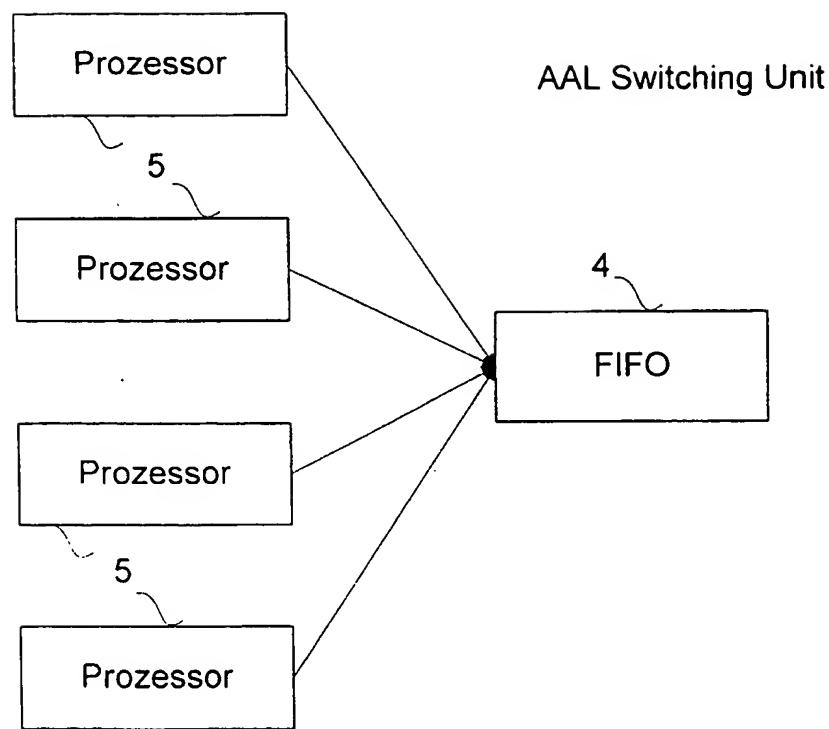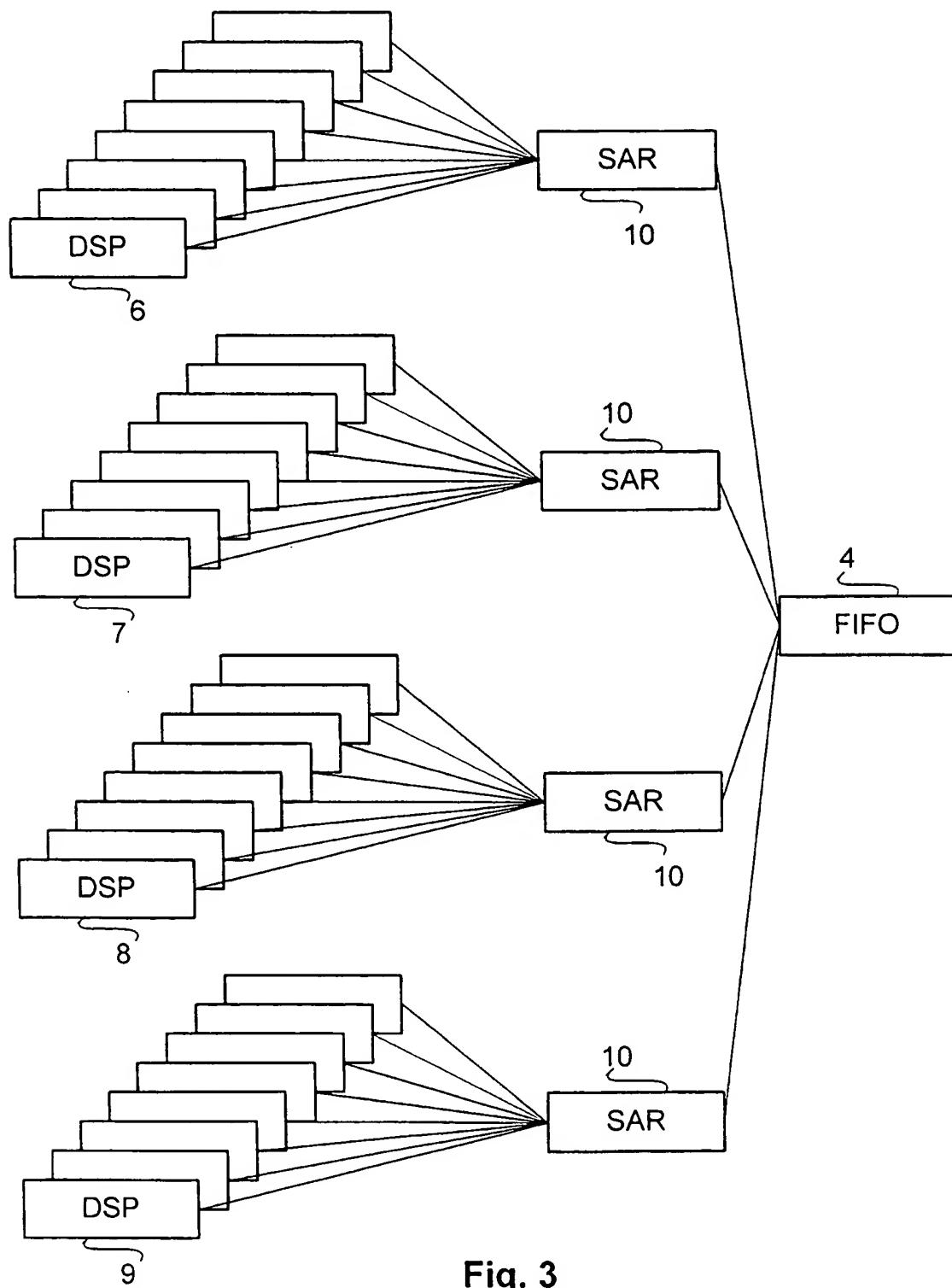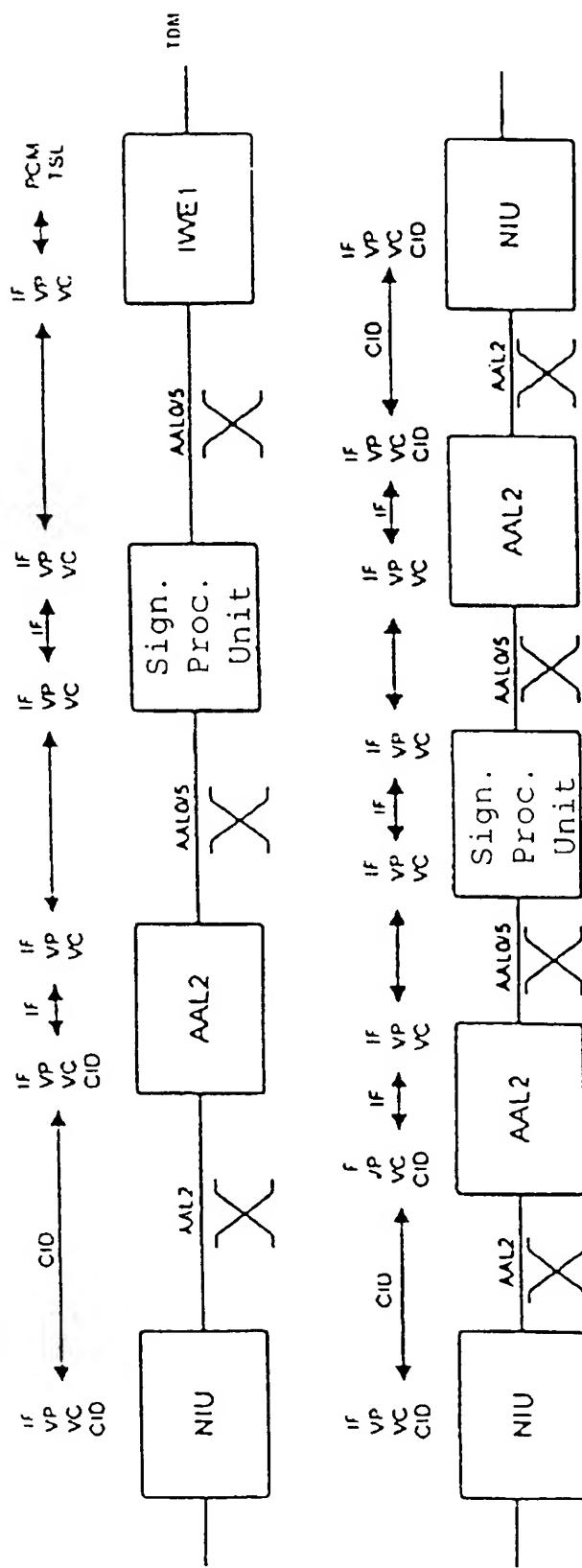
FIG. 4
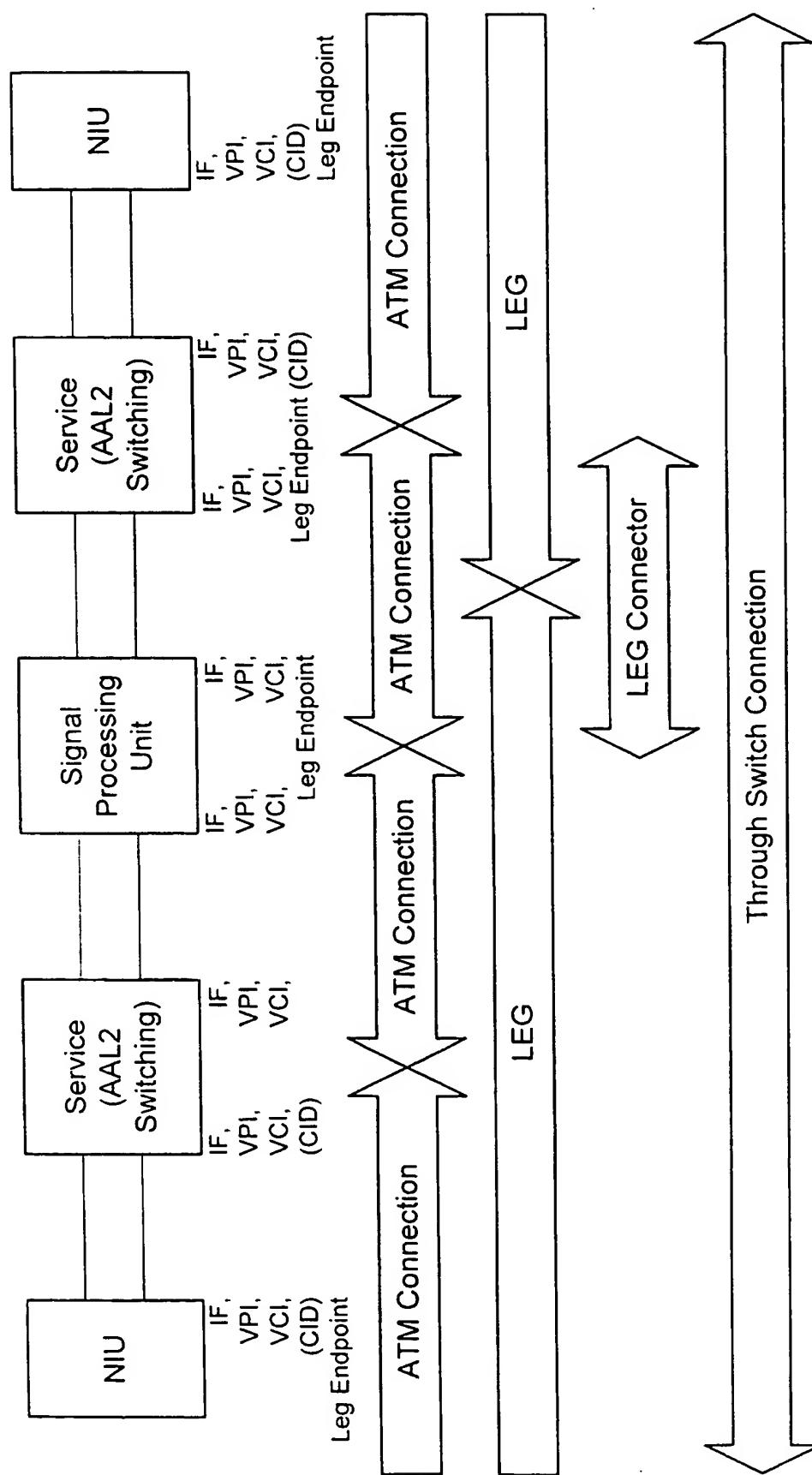
Fig.5

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7   H04Q11/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7   H04Q   H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 809 025 A (TIMBS JEFFREY L) 15 September 1998 (1998-09-15) column 2, line 65 -column 6, line 53 column 14, line 10 - line 20; claim 7	1-24
A	HEA-SOOK PARK ET AL: "The Design of Reliable Controller for Interprocessor Communication Network using ATM Switch" SYSTEM SCIENCES, 1998; PROCEEDINGS OF THE THE HAWAII INT CONF ON, vol. 3, 6 - 9 January 1998, pages 263-272, XP002901613 paragraph [03.2] abstract	1-24
A	WO 97 24841 A (CISCO SYSTEMS INC) 10 July 1997 (1997-07-10) page 18, line 1 - line 16; claims 1-7	1-24

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| X | Further documents are listed in the continuation of box C. | X | Patent family members are listed in annex. |

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 December 2000	24. 04. 2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Rickard Elg

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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2

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

nformation on patent family members

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